Relationships between Vehicle Mass, Footprint, and Societal Risk

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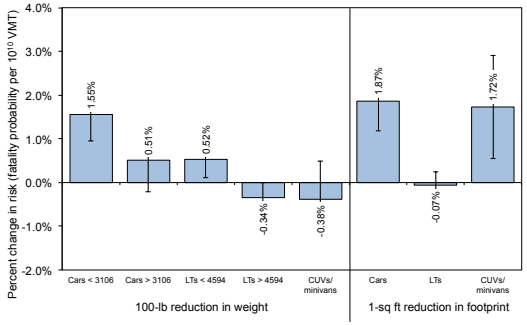
Background: NHTSA and EPA want to set new vehicle fuel economy/CO_2 standards that encourage down-weighting without compromising safety

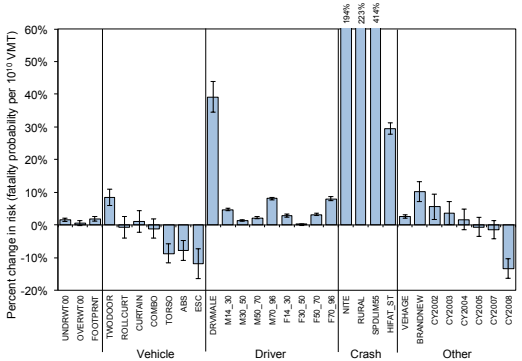
Method: Two phases:

1. replicate NHTSA 2012 regression analysis of US societal fatality risk per vehicle mile traveled (VMT)
2. regression analysis of societal casualty (fatality + serious injury) risk per crash, using data from 13 states

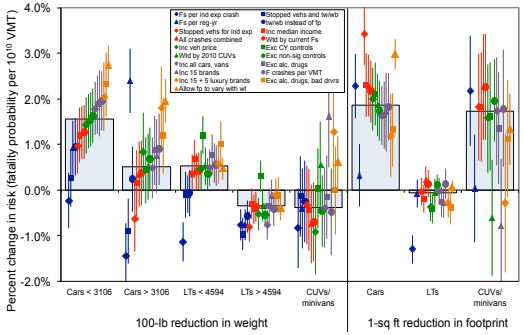
- We estimated the effect of reducing vehicle mass on societal risk, holding vehicle size (footprint) and other vehicle, driver, and crash variables constant, on recent vehicles (MY2000 to 2007, in CY2002 through 2008) using logistic regression
- Societal risk includes occupants of both subject vehicle and crash partners
- We estimated effects for three vehicle types (cars, light trucks/SUVs, minivans/CUVs) and nine crash types, for 27 separate regression models
- Cars and trucks split into two mass groups (cars: 3,106 lbs, light trucks: 4,594 lbs)



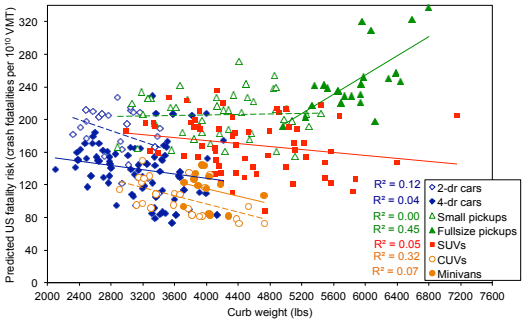
Mass reduction holding size constant slightly increases US fatality risk per VMT, particularly for cars less than 3,106 lbs; footprint reduction holding mass constant increases risk for cars and CUVs/minivans



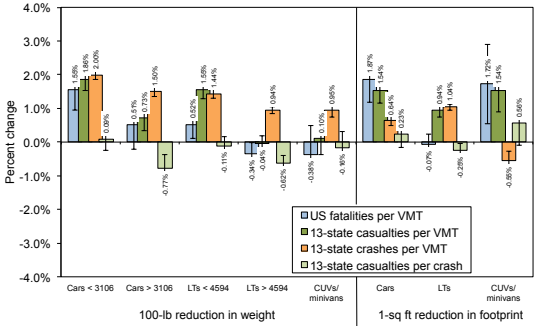
Other vehicle, driver, and crash factors have a larger estimated effect on fatality or casualty risk than mass or footprint reduction (figure shows effect on US fatality risk per VMT in cars)



Effect of mass reduction varies substantially under 19 alternative regression models, depending on measure of risk, control variables, and data used



Essentially no correlation between US fatality risk per VMT and curb weight by vehicle model, even after accounting for other vehicle, driver, and crash characteristics



13-state casualty risk per VMT is comparable to US fatality risk per VMT. Mass reduction increases crashes per VMT (crash frequency) but reduces casualty risk per crash (crashworthiness)

Conclusions

- Vehicle mass can be reduced while maintaining footprint without compromising societal safety, in all vehicles but the lightest cars
- Some light car models have the same risk as models that weigh hundreds of pounds more
- Historical relationship between mass and safety may not hold in the future with greater use of lightweight high-strength materials
- Replacing 80% of SUVs/small pickups, and 50% of large pickups, with cars/CUVs/minivans would reduce fatalities more (3.3%) than lowering pickup mass to that of cars (0.5%)
- A combined standard, where light trucks meet the same high standard as cars, could dramatically reduce fuel consumption while improving societal safety

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